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ABSTRACT

This booklet contains mathematics unit plans for Biology, Chemistry, and Physical Science developed by PACE (Promoting Academic Excellence In Mathematics, Science & Technology for Workers of the 21st Century). Each unit plan contains suggested timing, objectives, skills to be acquired, workplace relationships, learning activities with suggested teaching strategies, evaluation techniques, and resources. The unit plans for Biology include the following: micro-organisms, genetics, introduction to natural resources, cells (growth and reproduction), water, plant growth and reproduction, and disease and wellness. The Chemistry unit plans are: organic chemistry, atomic structure of the atom, radioactivity and nuclear chemistry, biochemistry, acids and bases, electrochemistry, equilibrium, gases, preparation of acid-base test paper, acid-base properties of household solutions, acid-base titration activities, analysis of hydrogen peroxide solution, and molar ratios using mass and volume. The unit plans for Physical Science are: Newton's laws of motion; electricity and magnetism; heat, temperature, and engines; and measurement. (MKR)

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Science Unit Plans

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Editors

PACE **Promoting Academic Excellence in Mathematics, Science & Technology for Workers of the 21st Century.**

Gary Community School Corporation
Merrillville Community School Corporation
Indiana University Northwest

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Science Unit Plans

Biology Unit Plans 1

Micro-organisms
Genetics
Introduction to Natural Resources
Cells (Growth & Reproduction)
Water - Sub-Unit 2
Plant Growth and Reproduction
Disease and Wellness

Chemistry Unit Plans 13

Organic Chemistry
Atomic Structure of the Atom
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Biochemistry
Acids & Bases
Electrochemistry
Equilibrium
Gases
Preparation of Acid-Base Test Paper
Acid-Base Properties of Household Solution
Acid/Base Titration Activity
Analysis of Hydrogen Peroxide Solution
Molar Ratios Using Mass and Volume

Physical Science Units 37

Newton's Laws of Motion
Electricity and Magnetism
Heat, Temperature and Engines
Measurement

Biology Unit Plans

Micro-organisms
Genetics
Introduction to Natural Resources
Cells (Growth & Reproduction)
Water - Sub-Unit 2
Plant Growth and Reproduction
Disease and Wellness

Planning group members:

John Littman, Ada Crosby, Reaner Boleware, Barbara Hilton

Joyce Williams, Johnny Barnes, and Charles Ward

Unit name: **Micro-organisms** Suggested time: **4 weeks**

Objectives

Concepts to be learned

Students will be able to:

1. Explain the roles that microorganisms play as:
   a. helpers (such as in industry and in the environment)
   b. villains (such as disease causers)
2. Recognize bacteria by shape: Coccus, bacillus, spirilla.
3. Recognize bacteria by gram stain results.
4. Determine how microorganisms are used to carry out fermentation in foods: Lactic acid, acetic acid, alcohol.
5. Determine how microorganisms serve as decomposers of waste materials.
6. Differentiate between a bacterial cell and a virus.
7. Analyze the environmental conditions vital to microorganisms: Temperature, moisture, salt concentrations, pH, oxygen.
8. Evaluate the role of microorganisms in different types of waste processing waste water, landfills.
9. Analyze the ways in which disease causing microbes are spread.
10. Describe the relationships microbes can have with other organisms: parasites, commensalism, mutualism, competition, active coexistence, predatory/prey.

Skills to be acquired

Students will acquire the following skills:

1. proper use of sterile techniques in handling cultures
2. inoculation of culture plates
3. collection of samples
4. observing biological processes such as decomposing
5. creating environments in which to observe microbial decomposition
6. culturing microorganisms found in environment
7. identifying bacteria by shape
8. staining bacteria to determine if Gram + or Gram -
9. building a bacterial cell model
10. using and reading pH paper to test certain foods for acid content
11. researching for information on diseases

Workplace relationships

Students will apply these skills in the following work related areas:

1. Clinical lab microbiologist (hospital.
2. Food services/Home economics (bakers, cooks, wine testers, dairies)
3. Environmentalist (in industry and government
4. Waste treatment specialist (hospitals, factories, city agencies)
5. Dermatologist (skin and microorganisms)
6. Soil conservation technician (agriculture, forestry)
7. Infection control specialist (hospital)

Learning activities / Teaching strategies to use

1. Students will use a bacterial culture to make yogurt by following any generic yogurt recipe. Students should review the topic of lactic acid fermentation prior to starting this activity.
2. Students will visit a waste water treatment plant (Gary Sanitary District) to observe the three main steps in processing waste water which includes a biological process involving microorganisms.
3. Students will build a bacterial cell model using two 1-liter plastic drink bottles cut 10 cm from the bottom. Items such as rubberbands represent plasmids and colored mop ribbon

represent DNA. Cell wall is the colored plastic bottom and the clear part represents cell membrane. Tape the items inside and tape the two bottles together.

4. Students will take prepared culture plates to various areas of the school and open for 5 minutes. They will return to the lab, cover plates, and incubate 48 hours. Prepare stained slides and view microbial growth under microscope. Have students draw pictures of what they see.
5. Students will test the effectiveness of various disinfectants such as ethanol, alcohol, isopropanol, clorox bleach, and Lysol. Students will use cotton swabs to inoculate prepared agar plates of specific areas before disinfecting. They will then clean the same area with a specific disinfectant, use a sterile cotton swab to inoculate a different plate and incubate both plates at 25 degrees Celsius 48 hours. Compare microbial growth on the two plates to see which has fewer colonies, thus making the best disinfectant. Students also may learn to count bacterial colonies on a culture plate. As a math component, the students can use various dilutions of the disinfectant, and record ratios.
6. Students will follow basic gram staining procedures to identify bacteria as whether they are Gram positive or Gram negative. Staining agents are saffranin and crystal violet. Students will discuss the factors that make them either one or the other.
7. Students will observe the effects microbes have on the rate of decomposition of various materials by using 2-liter plastic drink bottles cut off near the top. Using three different bottles, students will use three different types of soil (top soil, sterilized soil, and compost) to bury organic wastes such as fruit core, vegetable shreds, and paper. Making two layers, moisten as needed over 4 weeks and take temperature readings daily. Students will record readings, and uncover once each week to make observations as to rate of decomposition, etc. Wet and dry compost will be used to demonstrate environmental conditions.
8. Students will do research and report to the class on a specific disease caused by a virus or bacteria, noting method of transmission, cure, symptoms, and other pertinent factors.
9. Students will use pH paper to test foods preserved by canning and by using large acidity factors. Students will report their findings to the class.
10. Students will view prepared slides of microorganisms in the 4 main groups. They can list differences such as shape, size, color, etc.

Evaluation (other than paper and pencil exams)

Students will be evaluated by:

1. projects
2. oral reports
3. ability to record data from observations
4.. maintaining a portfolio

Resources:

Cord ABC Guide, Center for Occupational Research and Development, Waco, Texas.

Planning group members: Joyce Williams, Johnnie Barnes, Charles Ward

Unit name: **Genetics** Suggested time: **5 weeks**

Objectives

Concepts to be learned

1. Interpret the karyotic, using a knowledge of chromosomes, and show how they are inherited.
2. Explain how the sex of a child is determined.
3. Analyze the genetic relationship among members of the same family.
4. Contrast the inheritance pattern of a dominant trait with that of a recessive trait.
5. Predict the characteristics of offspring using a family of pedigree.
6. Predict the characteristics of offspring based on knowledge of genotype.
7. Explain what mutation is, and how it may affect inherited biological traits.

Skills to be acquired

1. Complete dominance: sickle cell anemia, eye color, hair color, blood type
2. Incomplete dominance: four-o'clocks (flowers), cattle (bulls and cows)
3. Dihybrid: TT YY x ttyy (plants), AABB x aabb (animals)
4. Trihybrid: TTRRYY x ttrryy (plants), AABBDD x aabbdd (animals)
5. Population genetics: P square + 2PQ + Q square = 1

Workplace relationships

1. Clinical Laboratory Technician
2. Emergency Medical Technician
3. Home Health Nurse
4. Occupational Nurse
5. Physician (all specialties.
6. Nurse Practitioner

Learning activities / Teaching strategies to use

1. View video "Colorblindness"
2. Assignments (working problems)
3. Taking part in class discussions
4. Read the text "The Use of the Pedigree in Genetic Analysis"
5. Read the remainder of the sub-unit
6. Do lab #6, "How Do We Inherit Our Biological Characteristics"
7. Bring in guest speakers on genetics

Evaluation (other than paper and pencil exams)

1. Observation of students work from day to day
2. Group working
3. Oral presentations

Resources:

1. *Cord ABC Guide*, Center for Occupational Research and Development, Waco, Texas.
2. Hardy-Weinberg

Planning group: Charles Ward

Unit name: **Natural Resources** Suggested time: **4 weeks**

Objectives

Concepts to be learned

1. Identify and give examples of natural resources.
2. Classify natural resources by the following:
   a. Limited resources c. Renewable resources
   b. Unlimited resources d. Nonrenewable resources
3. Explain how human activities endanger natural resources.
4. Give examples of methods to preserve natural resources.
5. Explain what depletion and degradation mean in terms of natural resources.
6. Analyze jobs to see how natural resources are involved in every job.
7. Identify alternatives to fossil fuels, and describe some benefits of each.
8. Explain two ways pollution has been reduced in the United States.
9. Describe ways to conserve energy.
10. Identify types of pollution and their causes and give examples of the hazards of pollution.

Skills to be acquired

1. Science process skills.
2. Observation skills.
3. Analyzing and problem-solving skills.
4. Critical thinking skills.
5. Cooperative learning / teamwork.
6. Measurement skills and techniques.
7. Utilize safe laboratory procedures.
8. Collect, organize and plot data on a graph.

Workplace relationships

1. Environmental and chemical analysis technician. - Air quality and water quality.
2. Powerplant operators. - Burn coal or petroleum in power plant boilers, operate ash handling systems.
3. Air pollution control technician or monitor. - Takes air samples, installs, operates and repairs air sampling devices to find out if harmful gases or particles are in the air.
4. Municipal waste water treatment technician. - Waste water treatment technician, reports on water quality.
5. Soil conservation technician. - Provides technical advice and assistance to farmers, ranchers, and other landowners to help prevent soil erosion.
6. Nutritional consultant, nutritionist. - Food analyst, natural resource values as food source.
7. Biologist and wild life managers. - To protect and conserve natural resources.
8. Miners, farmers, and fishers. - They gather natural resources for products, food, or as sources of energy.
9. Auto manufacturing workers. - They make products from natural resources.
10. Food processing workers. - They make products from natural resources.
11. Water treatment technicians, Aquatic biologist. - Collects samples from natural water bodies, industrial wastes, or other water sources.
12. Conservationists. - Organism preservation.

Learning Activities / Teaching Strategies to use

A. Focus Activities

1. Hold up a trash bag filled with objects which could be recycled: Plastic two liter soda bottles, plastic milk jugs, aluminum cans, cereal boxes, cookie bags, glass jars (pickles, jelly, jam, juice).
   a. Ask students if they recycle all of this.
   b. Ask if they have a recycling program in their community, neighborhood, or school.
2. Hold up popular types of clothing worn by most students: Hat, tennis shoe, jeans, sports "I.D." aparallel.
   a. Ask students why is it so popular.

b What materials are used to make this tennis shoe?
c. Can you run out of the materials used to make these articles of clothing?

3. Set up a display with samples of natural resources: pictures, portable oxygen tank, water, fossil fuels, soil, plants and animals.
4. Bring in speakers from natural resource related job.
5. Ask students to investigate recycling programs in their community.
   a. Have the students find out what kinds of materials are accepted for recycling.
   b. Have them give locations of collection points and days on which collections are made.
6. Give students a short magazine article to read about natural resources that include response provoking information.
   a. Have students write brief responses.
      1. Briefly tell what the article is about.
      2. What is their opinion?
      3. Give two reasons this article is important to read.
   b. Discuss.

B. Motivating Activities

1. Video "Introduction to Natural Resources" - Oral discussion based on questions from the video.
2. Cooperative group activity
   a. Group size: 3-5 students.
   b. Outcome: Students will be able to create a game or puzzle associated with natural resource terms that will teach them and their classmates the definitions or usages.
   c. Individual Accountability: Each group member will be responsible for completing part of the research needed to create the game or puzzle.
   d. Positive interdependence: Groups will name and construct the game or puzzle. Have each group member:
      - Select a position (leader, recorder, timer, messenger)
      - Select ____ number of terms
      - Define the terms selected.
      - Make up _____ number of rules
      - Construct and assemble game or puzzle
      - Participate in oral presentation to class (explain and play game)
3. List several items on the board in a chart form (computer, CD player, stereo system, car, tennis shoe, loaf of bread, desk).
   a. Ask students to name raw materials they would need if they wanted to make these items from scratch.
   b. Ask students which raw materials they believe might some day run out and which probably will not.
4. Have students pick a job that interests them from the list of jobs that are connected to natural resources. (Teacher provides list)
   a. Have them write a brief description of their chosen job. Include skills needed and tasks performed by people who hold the job.
   b. Then have them write how this job relates to natural resources.
   c. Interview someone whose job is directly related to natural resources.
5. Have students make a list of at least ten (10) things they would use if they were on another planet just like Earth, except that it has no people.
   a. Have them compare their list with lists made by other students. Students should add things they overlooked.
   b. From the list students should classify each natural resource on their lists in two different ways

- renewable or nonrenewable resources
- limited or unlimited resources

c. Have students make a table from these lists.
- renewable / nonrenewable resources
- limited / unlimited resources

d. Compare their table with those of other students and discuss the differences.

6. Give students a descriptive paragraph with location for a job site, the students' occupation and their responsibility for restoring the site to a usable state after it has been mined.
   a. Tell students, based on the information given, to decide which mining method they would recommend for the site described. Why?
   b. Have students answer questions:
      - How do you think this operation will affect natural resources in that area?
      - How will this effect on natural resources affect you personally (i.e. jobs, health, trasnportation, etc.) ?

7. Lab

Purpose - In this lab, students will observe the typical pattern of natural resource depletion.
Lab objective - Plot a resources depletion curve for a simulated mining operation.
Lab skill - Generate and graph a set of data.
Suggestion for this lab : Use Cord, *Natural Resources*, Unit Lab 1, pp. 22-25.

Evaluation (other than paper and pencil exams)

Oral and written reports
Simulated set-up activities
Lab practicals
Evaluation sheets from class / group
Project presentations
Oral and written quizzes
Test(s)
Cooperative learning group evaluation forms
Portfolios
Created application projects

Resources:

Heath Biology , text, lab manual, and resource materials. D.C. Heath & Company, 1991.
Biology Visualizing Life, text and resource materials Holt, Rinehart & Winston, Inc., 1991.
Biology Today, text and resource materials. Holt, Rinehart & Winston, Inc., 1990.
Cord Applied Biology /Chemistry, resource materials. (Natural Resources and Teaching Natural Resources Unit) Center for Occupational Research and Development, 1992.
Science World Magazine
Discovery Magazine
Video: "Introduction to Natural Resources"
Cord resource materials.

Planning group members: Reaner Boleware, Ada Crosby, Barbara Hilton, John Littman, Joyce Williams, Johnnie Barnes, Charles Ward

Unit name: **Cells (Growth and Reproduction)** Suggested time: **2 weeks**

Objectives

Concepts to be learned

1. Using a model, demonstrate how cells are organized and how they relate to their environment via a membrane.
2. Explain how to distinguish between two individuals by analyzing tissue samples.
3. Explain how DNA controls the activities of the cell.
4. Explain how a cell replicates.
5. Relate errors in cell activities to diseases in humans.
6. Construct a model of DNA.

Skills to be acquired

1. Use of a microscope
2. Prepare a wet mount slide
3. Observe living specimen using a microscope
4. Stain cells for viewing
5. Use pipette for transferring of liquids
6. Test for the presence of substances in solutions
7. Differentiate between various types of cells

Workplace relationships

1. A crime lab technician gathers and evaluates various lines of evidence from a crime investigation.
2. A toxicologist tests to determine the safety of the workplace.
3. A pathologist or medical technician examines cells and tissues for abnormal growth (cancer).
4. A patient care technician weighs, checks temperature and blood of incoming patients.

Learning activities / Teaching strategies to use

1. View the video "DNA Fingerprinting"
2. Read "Overview of the cell".
3. Do lab "Why are membranes important to cells?"
4. Do lab "How can DNA be obtained from cells?"
5. Read "How DNA controls the working of the cell".
6. Using prepared slides identify phases of mitosis.
7. Determine differences between different cell types.
8. Using a cell model, identify organelles and their functions.
9. Using models of DNA and RNA indicate replication, transcription, translation and the sequencing of amino acids at the ribosome.
10. Participate in class discussions and activities.
11. Do concept mapping.
12. Use of a computer.

Evaluation (other than paper and pencil exams)

1. oral examinations
2. laboratory practicals
3. project presentations
4. panel discussions

Resources:

Heath Biology, text, lab manual, and resource materials.
D.C. Heath and Company, 1991.
Some of the ideas were taken from the *CORD Communications ABC*

Planning group members: Johnnie Barnes, Charles Ward, Joyce Williams

Unit name: **Water - Sub-Unit 2** Suggested time: **2 weeks**

Objectives

Concepts to be learned

1. Link the physical and chemical properties of water to its function as a transporter of nutrients inside plants and animals.
2. Predict how selected organisms will react to environmental temperature changes, based on the role of water as a temperature regulator.
3. Describe the role of water in biochemical reactions in organisms.
4. Choose an organism and evaluate its ability to maintain water balance in an extreme condition.
5. Recommend strategies for supplying water to livestock.
6. Describe how diffusion and osmosis help animals and plants to obtain nutrients and maintain water balance.
7. Observe the movement of materials across a membrane and relate it to the concentration of material on each side of the membrane.
8. Determine the effect of concentration differences on the movement of water and solute across a membrane.
9. Measure mass with a triple beam balance.
10. Prepare and fill dialysis bag.

Skills to be acquired

1. Analyze and solve problems.
2. Use science process skills to conduct investigation.
3. Work productively and responsibly.
4. Demonstrate proper use and care of tools, equipment, and laboratory instruments.
5. Utilize safe laboratory procedures.

Workplace relationships

1. Water balance in aquatic animals. (Pet store or aquatic animals technician)
2. Rehydrating the body. (Sports trainer, athletes, medical professionals)
3. Effects of soil types on water availability. (Landscape gardener, landscape architect)
4. Cost effectiveness of raising animals for food in arid regions. (Breeder)
5. Fever as an indicator of illness. (Nurse)
6. Drowning. (EMT, emergency room doctor)
7. Quality of bottled waters. (Quality assurance technician, consumer products technician)
8. Reverse osmosis. (Water purification technician/supervisor)

Learning activities / Teaching strategies to use

1. Video, "The Chemical Nature of Water: Aquarium."
2. Scenarios, Job profiles.
3. Lab activities.
4. Cooperative learning.
5. Demonstrations.
6. Peer tutoring.
7. Research projects.
8. Visiting speakers.

Evaluation (other than paper and pencil exams)

1. Oral and written reports.
2. Portfolio.
3. Quizzes.
4. Sub unit exam.
5. Practical exercises.

Resources:

"Water," in *Applied Biology/Chemistry*, Teacher's Guide. CORD (Center for Occupational Research and Development) Communications, Waco, Texas, June 1993.

Planning group members: Reaner Boleware, Ada Crosby, Barbara Hilton, John Littman

Unit name: **Plant Growth and Reproduction** Suggested time: **6.5 weeks**

Objectives

1. Evaluate the role of different plant parts in the growth and reproduction of plants.
2. Investigate the conditions under which different types of plants grow and reproduce.
3. Rate the value of various plants for the following uses and give examples:
   a. human and other animal foods
   b. paper
   c. fabrics
   d. landscaping
   e. chemical compounds
   f. wood
   g. shading
4. Compare methods used by commercial growers to propagate plants.
5. Explain how a plant breeder creates a variety of plants with desirable traits.

Skills to be acquired

1. Properly use the triple beam balance to weigh items and substances
2. Match specimen to visual descriptions
3. Make drawings from observations
4. Observe and record data correctly
5. Section tissue of a living specimen
6. Use paper chromotography to separate pigments found in a sample
7. Measure volumes with a graduated cylinder
8. Use a mortar and pestle to grind tissue
9. Measure length using a metric ruler
10. Filter solids from a liquid
11. Use a solvent to extract chemical compounds from a plant sample
12. Identify external characteristics of a living organism
13. Count and group organisms based on external characteristics
14. Transplant plant cuttings
15. Practice sterile techniques required for successful tissue culture
16. Produce genetically uniform plants by an asexual method of propagation
17. Plant seeds and properly transplant seedlings
18. Control light, moisture, and temperature conditions for a growth process
19. Determine specific gravity of a solution using a hydrometer
20. Use a colorimeter to measure absorbance of a color solution
21. Add solute to a solution in the proper amount
22. Remove excess water from a slurry by pressing it between paper towels
23. Use a compound light microscope correctly
24. Interpret written data
25. Work with an ethic of being precise

Workplace relationships

1. Agriculture and agribusiness
2. Home economics
3. Health occupations
4. Industrial technology

Learning activities / Teaching strategies to use

1. Effect of the hormone gibberellin on plant stem growth: **Note:** In this activity, students will compare the growth of shoot tips on seedlings which they have applied deionized water and gibberellin solution. After observing and taking data for one week, the average length should be calculated for both plant seedlings and the data plotted on a graph showing changes in shoot length from day to day.
2. How do we extract color and essence from plant materials? **Note:** Students will use paper chromotography to separate plant pigments and use a solvent extraction process to produce fragrances from ground plant materials.

3. How do nutrients in the soil become available to plants? **Note:** This learning activity will be done in two parts. Part I, students are to examine the solubility of ions extracted from by water, acid, and base under pH conditions. In part II, students are to examine the solubility of salts under different pH conditions to determine the solubility of specific ions at high and low pH values.
4. How is seed for sale tested and labeled? **Note:** Students will test seeds for purity and viability and prepare an accurate label for a bag of seeds. A calculation of percent inert matter, foreign crop seeds, weed seeds, and noxious seeds for a seed sample will be carried by the students.
5. What conditions affect seed germination? **Note:** In this learning activity, students will use one of two methods to do germination tests on selected seed samples using petri dishes as germination chambers. The two methods are: 1) testing seeds by treating them in three ways to determine germination requirements; 2) testing seeds by placing them in three different types of soil to determine germination requirements.
6. Conventional method of vegetative propagation: **Note:** Students will grow new plants using several techniques, including stem and leaf cutting layering.
7. How are plants produced by tissue culture? **Note:** Students will practice plant tissue culture techniques.
8. How do plant breeders select varieties of plants to propagate? **Note:** Students will examine the seedlings grown from a previous activity for occurrence of genetic characteristics. Seedlings from a monohybrid and dihybrid cross will be counted by phenotypes. Students will reconstruct the genetypes of the parent plants by working a series of Punnet squares suggested by the ratio of the seedlings phenotype.
9. How is paper recycled? **Note:** To recycle paper, the recycling plant must convert the paper into pulp, then they can press the pulp back into paper. Students will examine one way to accomplish this process.
10. How can fibers be identified? **Note:** Students will examine several properties of known fabric samples. They will then compare the properties of the known fabric samples to the properties of the unknown fabric samples to enable them to identify the unknown fabric sample.

Strategies

1. Hands-on lab activities
2. Projects (individual and group)
3. Cooperative learning
4. Computer assisted instruction
5. Lecture
6. Class discussion
7. Field trips
8. Audiovisuals
9. Research (Individual and group)
10. Practical applications
11. Problem solving
12. Guest speaker/ Career awareness

Evaluation (other than paper and pencil exams)

1. Oral presentations
2. Quizzes
3. Portfolios
4. Class participation
5. Practicum
6. Projects (individual and group)
7. Exams (individual, group, take-home)

Resources: *Cord/ABC,* Prentice Hall
Biology, D. C. Heath

Group members: Barbara Hilton, Reaner Boleware, Ada Crosby, and John Littman

Unit name: **Disease and Wellness** Suggested time: **6 weeks**

Objectives

Concepts to be learned

Students will:

1. Describe major pathogens that infect the body.
2. List personal habits and environmental conditions which can allow pathogens (specifically microorganisms) to invade the body.
3. Compare and contrast the immune system of a healthy individual to a person with a weakened system.
4. Explain what conditions/diseases can weaken the immune system.
   Examples: AIDS, genetic disorders, chemotherapy, etc.

Skills to be acquired

Students will:

1. Research skills.
2. Writing skills.
3. Cooperative learning skills.
4. Laboratory skills.
   a. Prepare and stain bacterial slides.
   b. Use the microscope.
   c. Use sterile technique in growing and handling cultures.
   d. Use pipettes for liquid transfer.
   e. Test for an acid and base.

Workplace relationships

1. Medical Laboratory Assistant / Phlebotomist - Obtain blood samples and distribute to various testing areas. Additional duties will vary with different work environments.
2. Public Health Technician - Helps to find out where infectious disease starts.
3. Medical Laboratory Technician - Performs laboratory testing on all body fluids, bacteria, and in some cases viruses. Technicians also perform quality control in addition to trouble-shooting various types of technological equipment.
4. Any area of health care from physician to nurse, radiology technician, etc.

Learning activities / Teaching strategies to use.

Labs:

1. Gram Staining - In this activity, students will collect bacteria from a bacterial culture, and prepare a slide using Gram stain. The cells will be examined under the microscope. This activity will be done using sterile technique. Students will be able to distinguish between gram positive and gram negative bacteria. The shape of the bacteria will also be examined using the microscope.
2. How Does An Epidemic Spread? - This activity focuses on acids and bases, however this reaction represents the transmission of a contagious disease such as AIDS. Students receive cups of unknown solutions (0.001 M HCl or 0.1 M NaOH) and exchange several droppers-full with other students in the class and add phenol red indicator. If the solution turns red, the student has the disease; if it turns yellow, the student is not infected.
3. How Does the Medical Laboratory Diagnose Disease? Part 1: The Blood Smear - In this activity, students will prepare blood smears and stain with Wright stain. They will then identify the various types of cells (red and white) and platelets. They will also perform a differential cell count including red blood cells: Count all cells in a field seen under the microscope until they have counted 100 white blood cells. Each cell is to be recorded as it is

counted. Then they shall calculate the ratio of red blood cells using the following formula:

$$\text{red blood cells/white blood cells} = \frac{\text{avg. number of red blood cells}}{\text{avg. number of white blood cells}}$$

4. Group Activities (2-8) pg. 63.
   a. Student will work in small groups to build a white blood cell, using their imagination. They shall describe how their cell works to destroy bacteria. The students shall be allowed to use any material available to construct the cell.
   b. Activity (2-9) pg. 65. In this activity, students will work in small groups to determine how disease is spread. This can be done through research and inquiry (interviews). Findings will be put on a poster board and shared with the class.

5. Independent Activity (2-11) pg. 68. Students will work independently to research a given list of diseases that are shared by animals and humans.

6. Controversial Issue: Should AIDS patients be denied medical insurance? This is just one of many issues that can be used in this unit.

7. Field Trips.
   a. Local health facilities.
   b. Robert Crown Center (Chicago) - Topics: The Human Body, AIDS.

Evaluation (other than paper and pencil exams)

1. Laboratory practical.
2. Slide preparation.
3. Proper use of pipettes - size and technique.
4. Present research paper to class (individual).
5. Oral quizzes.

Resources:

Applied Biology / Chemistry "Wellness and Disease", Marshall, Jacquelyn, CORD Communications, June, 1993.

Planning group members: Reaner Boleware, Ada Crosby, Barbara Hilton, John Littman

Chemistry Unit Plans

Organic Chemistry

Structure of the Atom

Radioactivity/Nuclear Chemistry

Biochemistry

Acids & Bases

Electrochemistry

Equilibrium

Gases

Preparation of Acid-Base Test Paper

Acid-Base Properties of Household Solution

Acid/Base Titration Activity

Analysis of Hydrogen Peroxide Solution

Molar Ratios Using Mass and Volume

Group Members:

Brenda Quaak, Pat Toney, Shirley Moorehead, Mike Commons

Ken Coudret, Andrea Rybolt, and Don Slys

Unit name: **Organic Chemistry** Suggested time: **2 weeks**

Objectives

Concepts to be learned

1. Identify the allotropic forms of carbon.
2. Compare & contrast organic and inorganic compounds.
3. Distinguish alkanes, alkenes, alkynes, benzene, alcohols, and esters.

Skills to be acquired

1. Show models of the two bonding arrangements for the allotropic forms of carbon.
2. Draw the two bonding arrangements for the allotropic forms of carbon.
3. Draw structural formulas for the first 10 n-alkanes and correctly name them.
4. Draw structural formulas for hydrocarbon molecules given their molecular formulas.
5. Use IUPAC naming for organic compounds.

Workplace Relationships

Keil Chemical Company

USX Steel

I will take class time to interview each student to determine his goals and expectations for the future. I will have each student keep his own personal folder of his best work and keep it in the classroom throughout the year.

During the first week of school, I will have done a Parent Program Capability Inventory. Therefore, by the time this unit will be taught, I will know which parent works in an industry that makes use of a knowledge of organic chemistry. I will then show, from time to time, either a video of the parent at home or in his/her workplace using this knowledge.

I plan to canvass the Northwest Indiana area during my planning period, probably via the library as much as possible, to determine which industries and businesses which might employ students right out of high school, or with a maximum two year associate degree. I can visualize myself interviewing personnel people, ideally using a camcorder, to powerfully illustrate to students what sort of knowledge it is expected that they will have.

Learning activities / Teaching strategies to use

Day 1 Identify allotropic forms of carbon. Introductory Demo:

Obtain a 200 ml beaker and pour in 30 ml sucrose; add 10 ml concentrated sulfuric acid. A column of carbon is produced. Write the equation for the reaction on the board. Ask relative amount of water produced. What's this black stuff got to be?

Sugar is a chemical and a carbon compound.

Lab exercise

Purpose: To appreciate that sugar is a chemical; chemicals are a part of our everyday life, and not all chemicals are dangerous or poisonous.

Procedure:

Load a chemical bottle with sugar.

Pass out a paper towel to everyone...

Pour small sample from the bottle and direct students to attempt to identify the white crystalline solid.

Tomorrow's assignment: read pp. 634 - 638.

Day 2-3 Identify allotropic forms of carbon.

Lab activity: To make models of both types of bonding for the two carbon allotropes.

1. Prepare & reproduce paper triangles for student pairs to construct tetrahedron models. (per. p. --- in Holt teacher's book)
2. Have students make gumdrop-toothpick tetrahedral models of carbon atoms.
3. Each group produces the two models of carbon allotropic bonding.

Day 4 Compare and contrast organic and inorganic compounds.

Activity: Lab exercise in comparing organic with inorganic compounds.
Students should be in groups of two.
Supply students with several organic and inorganic compounds. Tell them which is which. Let them "play" with them, attempting to dissolve them, heat them, and attempt to burn them.
Have them write generalizations differentiating the two classes of compounds.

Day 5 Compare and contrast organic and inorganic compounds.
Activity: Lab exercise in separating organic from inorganic unknowns.

Day 6 Detonate a natural gas bomb
Students should be able to draw structural formulas for the first 10 n-alkanes and correctly name them.
Instructor writes the equation for combustion of methane on the board and enlists class involvement in balancing it.
Explain: Avogadro: "Equal volumes of gases contain equal numbers of particles."
Fill a plastic juice bottle with oxygen and methane in the proper proportions, detonate it with a 110v wire run through two holes in a rubber stopper inserted quickly into the bottle with gases: + connected to - with wisps of steel wool. Hearing impaired student inserts plug--steel wool ignites setting off gas mixture. Write ethane, propane, butane, on the board and have students complete study in Merrill, pp. 580-582.

Day 7 Students should be able to draw structural formulas for the first 10 n-alkanes and correctly name them.
Have students make gumdrop-toothpick models of some of the first 5 n-alkanes.
Have students write structural formulas of the alkanes after making the models.

Day 8
Make additional gumdrop-toothpick models of the rest of the alkanes and name them.
Announce quiz over the first 10 alkanes.

Day 9 Quiz: first 10 alkanes
Demo:
How many different isomers of butane can you make?
After making the models, draw the structural formula.
How many different isomers of pentane can you make?
After making the models, draw the structural formula.

Day 10-11
Homework assignment:
Obtain products around the house containing organic substances.
Copy down the list of organic ingredients.
Distribute copies of IUPAC standards for naming organic compounds.
Have student groups develop structural formulas of isomers and
and their names.
Assign pp. 582-586 in the Merrill book.
Quiz: IUPAC naming of isomers.

Day 12
Introduce halogen substituted n-alkanes in place of isomers.
Assign students tasks of naming substituted alkanes.
UNSATURATED HYDROCARBONS

Day 13

Introduce gumdrop-toothpick models of alkenes. Students make models of them.
Use IUPAC convention in naming where the double bond appears.
Assign p. 589 in the Merrill book.
COOKING OIL: SATURATED AND UNSATURATED

Day 14

Lab Exercise: Addition of a colored halogen to double bonds.
Obtain animal fat and add a few drops of iodine solution to see the non-effect on saturated hydrocarbon.
Obtain "polyunsaturated" cooking oil & add iodine solution to see the decolorizing effect of addition to double bond.
If this unit follows mole study, then they could do a quantitative study on the relative number of double bonds.

Day 15 IUPAC naming of cis-trans isomers.
Lab Exercise: make toothpick-gumdrop models, then write structural formulas and name them.

Day 16 Review

Day 17 Pretest

Day 18 Pen/paper test

Evaluation (other than paper and pencil exams)

Process measures (25%):
100 points for attendance and behavior
20 points for attendance in labs
Performance measures (25%)
Demonstrated lab skills
Tests and quizzes (25%)
Notebook (25%)

Resources:

Modern Chemistry, Holt, 1993
Chemistry A Modern Course, Merrill, 1987

Group Members: Brenda Quaak, Pat Toney, Shirley Moorehead, and Mike Commons

Unit name: **Structure of the Atom** Suggested time: **3 weeks**

Goals

1. Demonstrate that observations and mathematical calculations are important methods used in scientific research along with experimentation.
2. Compare the past model of the atom to present day atomic theory.

Objectives

Concepts to be learned

1. State a brief history of the development of the theory of atomic structure.
2. Discuss the dual wave-particle nature of light and the electron.
3. Explain the mathematical relationship among velocity, wavelength and frequency of electromagnetic radiation.
4. Define atomic number and mass number and their relationship to isotopes.
5. Define spectrum and spectroscopy and explain the use of spectroscopy to determine the structure of a substance.
6. Define photoelectric effect.
7. List and label the parts of a wave.

Skills to be acquired

1. Use a calculator (scientific).
2. Draw a concept map (Pictorial diagram/outline of information).
3. Calculate using the energy equation(s) E=mc , E=hv.
4. Apply factor-label method used to change conversion units.
5. Use a spectrometer to identify substances.
6. Write formal lab reports.
7. Light a Bunsen burner.
8. Apply appropriate safety rules in the laboratory.

Workplace relationships

1. Security Company - Photoelectric effect
2. Photography Technician - Light effect
3. Nuclear Plant Technician - Working with isotopes
4. Electronics Technician - Photoelectric effect
5. Electrical Contractor - Electrons
6. Forensics Technician - Crime lab - spectrometer
7. Clinical Laboratory Technician (Health)/Industry - Measure blood analysis
8. X-ray Technician (Health)/Industry - Electromagnetic energy
9. Environmental Organizations - Isotopes
10. Media Technician - Operates light and sound equipment
11. Nuclear Engineer - Isotopes
12. Electrical Chemist - Electrons

Learning activities / Teaching strategies to use

Computers - Practice drill: energy equations and parts of the atom.
Labs/Flame tests. (*Modern Chemistry*, Lab Manual pg. 55, Experiment 7.)
Research Projects: Chemistry and Industry/Heath.
Peer Tutoring.
Cooperative Learning.
Demonstrations: Neon lights (Merrill *Chemistry*. pg. 96)
Video: The World of Chemistry #6, "The Atom".
Activity: Atomic Spectra (Merrill *Chemistry*. pg. 802,)
Demonstration: Exciting Atoms by mechanical means. *Modern Chemistry* pg. 96 B
Field Trips

Speakers from the community
Black box lab

Evaluation (other than paper and pencil exams)
Oral reports involving critical thinking skills.
Research and write a report.
Project: Wave theory and particle theory.(*Modern Chemistry*, p. 125)
Apply models: Photoelectric effect. (*Modern Chemistry*, p. 125)
Inferring conclusions and verifying your inference.(*Modern Chemistry* p. 124)
Write formal lab report.

Resources: Books, journal articles, videos, computer software
1. *Merrill Chemistry*, Glencoe, 1993.
2. *Modern Chemistry* (text and lab manual), Holt, Rinehart, and Winston, 1993

Planning group members:
Patricia Toney, Brenda Quaak, Shirley Moorehead, and Mike Commons

Unit name **Radioactivity/Nuclear Chemistry** Suggested time: **5 weeks**

Objectives

Concepts to be learned

1. radiation, radioactivity, and radioactive decay.
2. half-life and its application
3. uses of nuclear chemistry.
4. benefits and risks of nuclear chemistry and how it relates to the students' cluster area. (Waste will be included here)

Skills to be acquired

1. Students will identify types of radiation.
2. Students will develop the architecture of the atom.
3. Students will calculate the molar mass of isotopes.
4. Students will graph half life and interpret graph.
5. Students will write a balanced decay equation.

Workplace Relationships

1. Radiologist
2. X-ray Technician
3. Mammography Technician
4. Police officer
5. Energy consultant
6. Plant designer
7. Radon Task Force
8. Oncology
9. Radiation Therapist
10. Civil Engineer
11. Waste Disposal (engineer)
12 Contamination and Decontamination Specialist
13. Commercial and Residential Contractor
14. Consumer Food Preservation

Learning activities / Teaching strategies to be used

Labs - Teacher directed working towards student autonomy

1. Black Box Lab - The purpose of this lab is to simulate the use of indirect evidence to infer properties that can not be perceived by all of our senses. The emphasis in this lab is on reasoning processes and how they apply to the development of the atomic structure. (Found in many chemistry lab books, *ChemCom* p. 281)
2. Isotope Pennies - The purpose of this lab will be to simulate the isotopic nature of elements and to calculate average atomic masses using pre- and post- 1982 pennies. (*ChemCom* pp. 285-286)
3. Licorice half-life graph - The objective of the lab is to demonstrate the fractional decrease in the original amounts of a radioactive material (half-life). Students will then plot the results and do a second home activity showing the similarity in half-life graphs and predict decay amounts. (see attached lab sheet)
4. Simulating a Radioactive Decay Chain - The objective of this lab is to simulate a three member radioactive decay chain. To use the knowledge gained to understand some current problems related to the use of nuclear power. (*Global Science Laboratory Science* pp. 173-175)
5. Cloud Chamber experiment - The purpose of this laboratory is to observe direct evidence of nuclear radiation and to observe evidence of probable background (cosmic) radiation. (*Global Science* Laboratory Science pp. 167-168)

Classroom Demonstrations - Teacher directed learning

1. α, β and γ Rays demonstration - This demonstration will familiarize students with the different types of radiation and the different types of material used to shield each of these radiation sources. (*ChemCom* pp. 291-294)
2. Video *In France It Works*, NBC, Whitepage late 1980's - This is a very positive look at a the uses of nuclear power as an alternative form of energy.
3. Video about the Chernobyl accident; PBS has done several documentaries. These tend to lead

towards a negative perspective of nuclear power as an alternative form of energy.

Classroom discussions

1. Nuclear Phenomena Survey - Survey will be used at the beginning of the unit to test the students knowledge and understanding of nuclear science. Then during the unit the students will survey other people, compile the data and make some judgments about the need for knowledge in this area of chemistry. On the last day of the class, students will take the survey again. (*ChemCom*. 273-274)
2. Chain Reaction with "You Decide" - A demonstration showing the difference between expanding and limited chain reactions. This can be used in conjunction with the videos of nuclear power plants. (*ChemCom* p. 310-311)
3. Potential "Benefits and Risks"; - This material can be used to discuss the biological effects of ionizing radiation and the risks that you take. (DOE materials unit 3 p. 15-25 and unit 2 p. 21-29)

Field Trips and Speakers

- Cook Nuclear Power Plant Tour - located in Benton Harbor, Michigan
- Visit Radiology Department - local hospital
- X-ray technician speaker - local medical facility
- Radon Task Force (EPA) speaker

Projects and Reports

- Radon testing prevention and reduction - students' home or find a volunteer in the neighborhood. (see assessment)

Quizzes

- Plan to have an ongoing trivial pursuit game developed by the students in the class.

Evaluation (other than paper and pencil exams)

- **Labs**
  Written laboratory reports and laboratory practicals will be done for assessment. A practical for this unit will be given for the penny isotope. Two objects different from the pennies will be given to the students and they will have to find the ratio of the objects in a container (the objects will represent isotopes).
- **Demonstration, Discussion, Field Trips, and Speakers**
  Students will be assessed based on attendance and oral and written contributions. Students will need to contribute to the activity in the form of questions or written responses.
- **Projects and Reports**
  The radon project will involve both school and the community. Within the first week of the unit students will be doing radon testing either in their home or somewhere in their community. The objectives will be to determine radon levels, examine the structural and geological patterns that affect the levels of radon and devise the means to measurably reduce the radon level. The students will have to report to the instructor in written and oral form. The students will also report to and receive feedback from the people whose houses we will be testing. The students will be required to report to these residents in a manner in which the information will be understood.

Resources

Science, Society and America's Nuclear Waste, Department of Energy, 1991.
ChemCom: Chemistry in the Community, Kendall Hunt, 1993.
Global Science: Energy, Resources, and Environment, Kendall Hunter, 1994.
Turn Your Students Into Radon Slueths, Roberts, Sharon. NSTA November 11, 1993.

Planning group members:

Patricia Toney, Brenda Quaak, Shirley Moorehead, and Mike Commons

Unit name: **Biochemistry** Suggested time: **4 weeks**

Objectives

Concepts to be learned

1. To realize the important role that biochemistry will play in the personal and professional lives of students.
2. To use principles of biochemistry to think more intelligently about current issues they will encounter that will involve science and technology.
3. To incorporate technology into the chemical processes that play such a vital role in our society.
4. To describe how 20 amino acids can combine to form millions of different protein molecules.
5. To describe the general structure of a carbohydrate, a lipid, a protein, and a nucleic acid molecule.

Skills to be acquired

1. Use diagrams to sequence the events in the understanding of the structure and function of DNA.
2. Use graphs to relate and explain the effect of temperature to enzyme activity.
3. Infer how a new infectious disease might arise and how chemicals may help treat the disease.
4. Perform and determine chemical tests on foods for organic nutrients.
5. Describe the process used to mass-produce antibodies.

Workplace relationships

1. Determining the blood cell count of patients in a hospital or clinic.
2. Preparation of blood for blood banks and giving blood transfusions.
3. Giving diagnostic tests for medical uses, such as the thyroid tests.
4. Cytotechnicians providing information for governmental agencies.
5. A dietitian determining the nutrients in foodstuffs for meal preparation at schools, hospitals, diet centers, etc..
6. Performing glucose tolerance tests.
7. Lab technicians studying tissues.
8. DNA fingerprinting for law enforcement departments, hospitals, research.
9. Performing tests for diagnosing cancer and other diseases.
10. Researcher using enzymes to change substances that the human body cannot easily digest.
11. Technicians in the gelatin industry using enzymes.
12. Biochemist performing studies on organic substances.

Learning activities / Teaching strategies to use

1. Group discussions on the issues of genetic engineering.
2. Laboratory Activity: Construction of Models of Organic Compounds, Heath *Biology*, 1991.
3. Demonstration: The Effect of Enzymes on Liver, *ChemCom* by Kendal/Hunt Co..
4. Laboratory Activity: Preparation and Testing of Aspirin, Merrill *Chemistry*, 1987.
5. Laboratory Activity: Hydrolysis of Starch, Heath *Chemistry Lab Experiments*, 1987.
6. Group projects on topics in biochemistry, such as gene cloning, retroviruses, etc..
7. Field studies at the Methodist Hospital Laboratory, Northlake Campus.
8. Laboratory Activity: How Can We Be Fingerprinted Through Our DNA? (Running Gel Electrophoresis, Staining and Analyzing DNA Bands, CORD: *Continuity of Life*.

Evaluation (other than paper and pencil exams)

1. Laboratory reports
2. Concept maps
3. Research reports
4. Laboratory practical exam
5. Group projects
6. Portfolio for the Chem Tech course

Resources: Books, Journal articles, videos, computer software

Biology Laboratory Manual, Heath, 1991
Chemistry Laboratory Manual, Heath, I987
ChemCom , by Kendall Hunt Publishing Company, 1992
Chemistry Experimental Foundations, Merrill , 1987
Methodist Hospital - Northlake Campus, Gary, IN
Videos by Holt, Rinehart and Winston

Planning group members:

Patricia Toney, Brenda Quaak, Shirley Moorehead, and Mike Commons

Unit name: **Acids and Bases** Suggested time: **3 weeks**

Objectives

Concepts to be learned

1. To use the important role that chemistry will play in their personal and professional lives.
2. To incorporate technology into the chemical processes that play such a vital role in our society.
3. To prepare students for further science education or to enter the workforce.
4. To demonstrate proper selection, use, and care of tools, equipment, and laboratory instruments.
5. To demonstrate the proper use of a microcomputer or calculator to assist in data collection and analysis.
6. To exhibit productive behavior as a member of a project team.

Skills to be acquired

1. Describe the characteristics of acids and bases (weak and strong).
2. Perform titrations using the appropriate equipment and techniques.
3. Measure pH by using the appropriate equipment and techniques.
4. Perform acid and base calculations such as pH and hydrogen ion concentration.

Workplace relationships

1. The production of car batteries made up of acids.
2. The production of various cleansing products used both commercially and in the household.
3. The use of the titration process used in industry to determine the concentration of various solutions (Such as in the CocaCola or Pepsi companies.)

Learning activities / Teaching strategies to use

1. List and show various solutions which consist of acids and bases.
2. Provide examples for uses of acids and bases in the household as well as commercially.
3. Calculate the pH of a substance from its hydrogen ion concentration (reverse the process).
4. Measure the pH of various substances using indicators.
5. Measure the conductivity of acids, bases, and salts using a computer / software.
6. Determine by titration the concentration of a sodium hydroxide solution with hydrochloric acid and the concentration of acid in a clear soda with the appropriate base.
7. Determine by titration the mass of base in an antacid using the appropriate acid.
8. Make a universal indicator from red cabbage, blueberries, or black beans and construct a rainbow by filling microwells with various concentrations of acids and bases and then adding the previously made universal indicator.

Evaluation (other than paper and pencil exams)

1. Identification of an unknown solution by measuring the pH and comparing it to known products.

Process Measures:

40% Laboratory Projects including lab reports
20% Examination
10% Quizzes / Homework
20% Laboratory Practical (Evaluation #1)
10% Portfolio consisting of class notes, handouts, and lab reports

Resources: Heath *Chemistry* and other available chemistry texts.

Planning group members: Ken Coudret, Andrea Rybolt, and Don Slys

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Unit name: **Electrochemistry** Suggested time: **3 weeks**

Objectives

Concepts to be learned

1. To prepare students for further science education or to enter the work world.
2. To incorporate technology into chemical processes that play such a vital role in our society.
3. To use the principals of chemistry to think more intelligently about current issues they will encounter that involve science and technology.
4. To demonstrate proper selection, use and care of tools and laboratory instruments.
5. To demonstrate the proper use of a microcomputer or calculator to assist in data collection and analysis.
6. To exhibit productive behavior as a member of a project team.

Skills to be acquired

1. Differentiate between reduction, oxidation, and reducing and oxidizing agents.
2. Analyze atoms, compounds, and ions and determine the respective oxidation numbers.
3. Illustrate the Laws of Conservation by balancing a redox equation.
4. Predict the spontaneity of a redox equation by using a chart of standard reduction potentials.
5. Calculate the voltage of a voltaic cell by using a chart of standard reduction potentials.
6. Design and construct an electrochemical cell and measure its cell potential.

Workplace relationships

1. Any company that produces batteries such as Eveready or Duracell, which are used for devices such as flashlights, jam boxes, cameras, calculators, toys, watches, semiconductors, power tools, and others.
2. Batteries involved in transportation constitutes a very large industry.
3. The disposal of batteries is becoming more significant since batteries are in the category of a hazardous waste.

Learning activities / Teaching strategies to use

1. List or show various devices which depend on batteries as a power source.
2. Demo: Observe and analyze a solution of silver nitrate with a strip of copper.
3. Demo: Place a penny and strip of zinc into a lemon about 1cm apart and attach a voltmeter. The voltage should be about 0.15V.
4. Demonstrate the technique of determining oxidation numbers and balancing redox equation.
5. Construct on electrochemical cell and then draw the cell on the board. Have a question and answer session concerning the cell. Then have the students predict the spontaneity of the cell by using a chart of standard reduction tables and calculate the cell potential.

Evaluation (other than paper and pencil exams)

1. Groups of students would design and construct an electrochemical cell from a given set of materials. The students would calculate the cell potential using standard reduction tables. Finally, the students would construct the electrochemical cell.

Process Measures:

20% Laboratory Projects including lab reports
30% Examination
10% Quizzes / Homework
30% Laboratory Practical (Evaluation #1)
10% Portfolio consisting of class notes, handouts, and lab reports

Resources: Heath *Chemistry* and other available chemistry texts.

Planning group members: Ken Coudret, Andrea Rybolt, and Don Slys

Unit name: **Equilibrium** Suggested time: **3 weeks**

Objectives

Concepts to be learned

1. To use the important role that chemistry will play in their personal and professional lives.
2. To incorporate technology into the chemical processes that play such a vital role in our society.
3. To prepare students for further science education or to enter the workforce.
4. To demonstrate proper selection, use, and care of tools, equipment, and laboratory instruments.
5. To demonstrate the proper use of a microcomputer or calculator to assist in data collection and analysis.
6. To exhibit productive behavior as a member of a project team.

Skills to be acquired

1. Develop basic and essential laboratory skills such as pipetting, dilution schemes, preparing solutions of various concentrations.
2. Operate equipment, ie Spectronic 20.
3. Understand and use Beer's Law as it relates to equilibrium.
4. Predict how equilibrium will be affected by changing certain variables.

Workplace relationships

1. The laboratory techniques listed previously are used in a variety of industries.
2. The manipulation of equilibrium in order to produce a greater yield of products is of major importance in many industries.

Learning activities / Teaching strategies to use

1. A laboratory activity will be used to develop the concept of chemical equilibrium and how it is mathematically derived from student data.
2. A demonstration involving two students and a set of pop-beads will be performed to simulate equilibrium at the molecular level.
3. Demonstrate that by changing the temperature of a gas tube containing N_2O_4 and NO_2 gases a shift in equilibrium may be predicted and observed.
4. A video focusing on rates and equilibrium.
5. The completion of problem sets.

Evaluation (other than paper and pencil exams)

1. The student will be asked what he or she would do in order to obtain a higher yield of product with greater efficiency if he/she were employed at a chemical plant.
2. To search for other examples for the uses of equilibrium in the current technology of industry.

Process Measures:

30% Laboratory projects including lab reports
30% Examination
10% Quizzes / Homework
20% Laboratory Practical (Evaluation #1)
10% Portfolio consisting of class notes, handouts, and lab reports

Resources: Heath *Chemistry* and other available chemistry texts.

Planning group members: Ken Coudret, Andrea Rybolt, and Don Slys

Unit name: **Gases** Suggested time: **3 weeks**

Objectives

Concepts to be learned

1. To use the important role that chemistry will play in their personal and professional lives.
2. To incorporate technology into the chemical processes that play such a vital role in our society.
3. To prepare students for further science education or to enter the workforce.

Skills to be acquired

1. Describe properties and characteristics of gases and how they are affected by changing the variables of temperature, pressure, and volume.
2. Understand and apply the gas laws (Ideal Gas, Charles's, Boyle's, Dalton's, etc.) by performing calculations in a problem-solving format.
3. Perform gas law measurements in a laboratory setting using the proper technique and equipment accurately.
4. Demonstrate the ability to incorporate the gas laws with laboratory measurements in order to solve a problem.

Workplace relationships

1. The hydraulic industry incorporates the knowledge of gases in its technology.
2. Air conditioning and heating systems are dependent upon the knowledge of gases.
3. Any industry that deals with bottled gas or contained gas must be knowledgeable of gas characteristics.
4. To demonstrate proper selection, use, and care of tools, equipment, and laboratory instruments.
5. To demonstrate the proper use of a microcomputer or calculator to assist in data collection and analysis.
6. To exhibit productive behavior as a member of a project team.

Learning activities / Teaching strategies to use

1. Demonstration of the Cartesian diver, heating a can followed by cooling with water, placing a marshmallow in a vacuum container, and electrolysis of water.
2. Students solve problems involving gases with emphasis on actual data.
3. The use a video showing properties of gases.

Evaluation (other than paper and pencil exams)

1. A laboratory experiment involving the production of hydrogen gas by reacting hydrochloric acid with magnesium.

Process Measures:

20% Laboratory Projects including lab reports
30% Examination
10% Quizzes / Homework
30% Laboratory Practical (Evaluation #1)
10% Portfolio consisting of class notes, handouts, and lab reports

Resources: Heath *Chemistry* and other available chemistry texts.

Planning group members: Ken Coudret, Andrea Rybolt, and Don Slys

Preparation of Acid-Base Test Paper

Many flowers and berries contain chemicals which have one color in an acid solution such as vinegar and a different color in a basic solution, such as a mixture of baking soda and water. In this activity you will make a piece of acid-base test paper. You will be able to take it home and test liquids in your kitchen.

1. Gather the following equipment:
   250-ml beaker
   four pieces of filter paper (12 cm diameter)
   tongs
   paper towel
   dropping pipette
   a set of pH buffers 2,4,6,7,8,10, and 12 (one per group)

2. Obtain about 50 ml of colored juice in a 250 ml. beaker. Record at the top of TABLE #1 the name(s) of the colored material used. We will complete the table after the paper is dry.

Table #1

Plant material used:	Color of Acid-Base Indicator Paper
pH = 2 Strongly Acidic	
pH = 4 Acid	
pH = 6 Weakly Acid	
pH = 7 Neutral	
pH = 8 Weakly Basic	
pH = 10 Basic	
pH = 12 Strongly Basic	

3. Using a pencil, write your name on each of the four pieces of filter paper.

4. Turn the hot plate on to a low setting, about 3, and evaporate about two-thirds of the colored alcohol solution, leaving about 17 ml in the beaker.

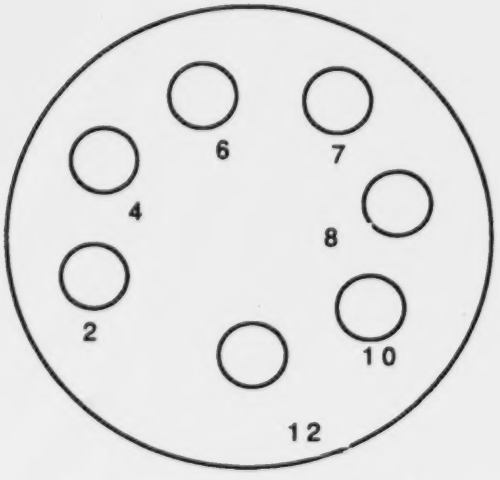
5. Once the evaporation of the alcohol is finished, use tongs to remove the hot beaker from the hot plate and allow it to cool.

6. With the side with your name on it facing down, place the pieces of filter paper on a large sheet of shelf paper or paper towel. Use a dropping pipette to place 1-2 drops of colored alcohol solution in a pattern like that shown below on each piece of filter paper. Discard the remaining colored solution in the sink.

7. When the paper is dry, place a drop of pH= 2 buffer on one piece of the acid-base test paper that you have made. Set the other three pieces of filter paper aside. You will use these later. Write the number 2 on the filter paper near the spot so you can remember which buffer goes with each spot. In Table #1, record the color of the wet spot on the test paper.

8. On the *same piece of filter paper*, repeat step #7 using each of the other buffer solutions (pH = 4,6,7,8,10,12). This will be your calibrated piece of acid-base test paper.

Put everything away and clean your area using the proper procedures.



Acid-Base Properties of Household Solution

In this activity you will test household solutions to find out if they are acidic, neutral or basic. You will use the test paper that you have prepared and samples of household chemicals in dropper bottles (one set per group).

1. Test some or all of the different household products with your acid-base test paper. Compare the colors your test paper turns to your calibrated piece you prepared earlier. Record your results below in TABLE #2.

Table #2

SAMPLE	Color of Paper after Tested	Acidic, Basic or Neutral	Estimated pH
Tap Water			
Distilled Water			
Bubble- Up			
Vinegar			
Window Cleaner			
Baking Soda			
Lemon Juice			
Detergent			

2. You might take your acid-base test paper home and test other solutions around you house. (What do you think the pH of the coffee or tea your parents may drink? Or how about the water in a swimming pool?)

ACID / BASE TITRATION ACTIVITY

Thus far we have known the concentrations of each of the solutions involved in the experiment. What if we do not know one of the concentrations of the solutions being used? How could we find the missing concentration?

To achieve this concentration, chemists working in industry and research use what is called volumetric analysis. Volumetric analysis is the process in which you accurately find the volume of one solution which will react with a carefully measured amount of another solution. The method used to do this is called titration.

In this experiment, you will determine the concentration of a base by titrating it with an accurately known concentration and volume of an acid solution which you made in an earlier activity. In the next part, you will titrate a solid acid with the base of known concentration and volume of the base from the first part.

Equipment:

ringstand
buret clamp
2 50 ml. burets
250 ml. Erlenmeyer flask
2 100 ml. beakers
base solutions A, B, C, D
acid solution HCl 0.15M
phenolphthalein indicator
solid acid 1-5

Procedure A:

1. Rinse two 50 ml. burets with tap water.
2. Into one of the 100 ml. beakers pour enough of the 0.15M HCl to fill the buret. Pour enough of the base that you have chosen into the other 100 ml. beaker to fill the other 50 ml. buret.
3. Choose one of the bases labeled A, B, C, or D. Your partner must choose a different lettered base.
4. As you face the ringstand and buret clamp, the buret on the left should contain the acid and the one on the right the base. (REMEMBER A B)
5. Rinse the buret on the left with about 10 ml. of the acid and then fill it to the top.
6. Repeat step 4 with the other 50 ml. buret and the base.
7. Remove the air from the tip of each of the burets catching the solutions in their respective 100 ml. beakers. **Start with each buret reading 0.0 ml.**
8. Rinse the Erlenmeyer flask with some tap water. Add approximately 10 to 20 ml. of distilled water. You do not have to measure this amount.
9. Add 3 or 4 drops of phenolphthalein to the flask. (Note the readings of the burets.) Add exactly 10.0 ml. of the 0.15M HCl to the flask.
10. Begin to titrate with the base by slowly adding it to the acid solution. Continue to add the base until one drop of the base turns the solution a faint pink. **Be careful not to go too fast or you will go beyond the end point.** Make sure the solution stays pink for at least 30 seconds. (NOTE: One or two drops of HCl should turn the solution clear again.)
11. Rinse out the flask with tap water and repeat steps 8,9 and 10. The number of ml. of the base NaOH should be very close.

DO THE FOLLOWING CALCULATIONS BEFORE GOING ON TO PART B (SHOW YOUR WORK)

1. Calculate the number of moles of HCl used in each titration. For example, if you used 10.0 ml. of 0.4M HCl, you would have:

$$10\text{ml HCl} \times \frac{0.4\text{ moles}}{1\text{ l}} \times \frac{1\text{ l}}{1000\text{ml}} = 0.0004\text{ moles}$$

2. Write the equation for the reaction in this experiment. Remember that the reactants are HCl and NaOH. Calculate the number of moles of NaOH needed to react with the calculated moles of HCl that you started with.
3. The number of moles of NaOH calculated in question 2 is contained in the volume of NaOH that you titrated in step 10 in the procedure. Knowing that the units for concentration or molarity are moles per liter, calculate the concentration of the NaOH. **Use the average of the two numbers you obtained from the titrations.**

Procedure B:

1. Prepare only one 50 ml. buret per instructions in step 1 Part A.
2. Rinse and fill the buret with the base you used in Part A. You calculated its concentration in calculation number 2.
3. Pick one of the solid acids (1-5). Your partner must use the same number also. Measure the mass of a piece of weighing paper. To this mass add 0.50 g of solid acid. Add the solid acid from the bottle until the arm of the balance swings up. Rebalance the arm and record the mass. **THERE IS NO NEED TO GET EXACTLY 0.50 g.**
4. Clean and rinse the Erlenmeyer flask with tap water. Add approximately 20 to 30 ml. of distilled water and add the solid acid. Swirl the solution to get as much of the acid to dissolve as possible. Rinse down the sides with distilled water to get any of the acid off the sides of the flask. **Put in 3 or 4 drops of phenolphthalein and swirl.**
5. Titrate with the standardized NaOH from Part A. Make sure the faint pink color lasts for at least 60 seconds. In that time, keep swirling the solution. If the color fades away, add more of the base until it stays for the full 60 seconds.
6. Rinse out the flask with tap water. Your partner can now titrate his/her solid acid.

CALCULATIONS FOR PART B: (SHOW YOUR WORK)

1. From Part A, You know the concentration of NaOH. Calculate the number of moles of NaOH used to titrate the solid acid.
2. Calculate the moles of hydrogen or hydronium ions that were contained in the 0.50 g sample of the solid acid.
3. Calculate the molecular mass of the solid acid. Remember the units for molecular mass are grams per mole.

DATA TABLE:

PART A:

1. Letter of base used.	
2. ml if 0.15 M HCl used (1)	
3. ml of unknown NaOH titrated (1)	
4. ml of 0.15 M HCl used (2)	
5. ml of unknown base titrated (2)	
6. Concentration of NaOH (1)	
7. Concentration of NaOH (2)	
8. Average concentration of NaOH	

PART B:

9. Number of unknown solid acid	
10. Mass of the solid acid	
11. Molecular Mass of the solid acid	

QUESTIONS:

1. When the end point of the titration is reached, what does this indicate about the reaction between the acid and the base?
2. How many milliliters of 0.030M NaOH will exactly neutralize 20.0 ml. of 0.50M H_2SO_4?
3. How many milliliters of 0.200M HNO_3 will completely neutralize 30.0 ml. of a 0.71 M solution of KOH?

THE ANALYSIS OF HYDROGEN PEROXIDE SOLUTION

Heath *Chemistry* 1993

Although hydrogen peroxide occurs naturally in small quantities in dew, rain, or snow, H_2O_2 was first discovered in the laboratory. Hydrogen peroxide undergoes decomposition into oxygen and water according to this equation:

$$H_2O_2(l) \longrightarrow H_2O(l) + 1/2\ O_2(g)$$

This relatively unstable compound must be kept in a cool environment and away from light. For that reason, H_2O_2 dispensed in brown bottles.

In this experiment, you will use a solution of potassium permanganate, $KMnO_4$ (aq), of known concentration to titrate a sample of H_2O_2 in an acidic solution. The results of the titration will allow you to determine the concentration of the hydrogen peroxide solution.

The titration technique you will use is similar to that of acid/base titrations. However, this is a redox reaction in which electrons are transferred from one substance to another as one reactant is oxidized and another is reduced. The **unbalanced** equation for the reaction is this:

$$KMnO_4\ (aq) + H_2SO_4(aq) + H_2O_2(aq) \longrightarrow MnSO_4(aq) + K_2SO_4(aq + H_2O(l) + O_2\ (g)$$

The indicator for the reaction equivalence point is the reactant potassium permanganate itself. Potassium permanganate is red-violet in color, and the products are all colorless. At the first indication that the reaction mixture stays pale pink, the equivalence point has been reached.

OBJECTIVES:

1. ***Determine*** the volume of KMnO4 solution required to react with a given volume of H_2O_2 of unknown molarity.
2. ***Calculate*** the molarity of the hydrogen peroxide solution.
3. ***Determine*** the percent by mass of household hydrogen peroxide and compare your result with the percent given on the bottle label.

MATERIALS:

Apparatus		Reagents
50 ml graduated cylinder	buret	0.10*M* $KMnO_4$
10 ml graduated cylinder	buret clamp	H_2O_2
125 ml Erlenmeyer flask	ring stand	1.0 *M* H_2SO_4
Safety Goggles	lab apron	distilled water

PRE LAB:

1. Read the introduction and procedure before you begin.
2. Answer prelab questions 1-4 on the Report Sheet.

PROCEDURE:

1. Put on your laboratory apron and **safety goggles.**
2. Clean a buret and rinse with deionized or distilled water. Fill the buret with 0.10*M* $KMnO_4$ solution.
3. Using a 10 ml graduated cylinder or pipette, add 10 ml of hydrogen peroxide solution to a 125 ml flask. Then add 50 ml. of deionized or distilled water and 15 ml. of 1.0 *M* sulfuric acid. Swirl the flask gently to mix.
4. Record the initial volume of $KMnO_4$ on your data table and place the flask on a sheet of white paper under the buret.
5. Titrate the hydrogen peroxide solution until the color of the solution begins to turn pale pink. When the faint pink color persists for at least 30 seconds, you have reached the end point. Record the final volume of $KMnO_4$ (aq) on your data table.
6. Before leaving the laboratory, clean up all materials and wash your hands thoroughly.

REPORT SHEET

Name: _____ Date: _____ Hour: _____

Prelab Questions:

1. Balance the equation for the reaction. Keep in mind that the basis for balancing a redox equation is that the number of electrons lost by one reactant is equal to number gained by another reactant.

2. Household 3% H_2O_2 is approximately 3 g of hydrogen peroxide per 100 g of solution or 30 g per liter of solution. What is the approximate molarity?

3. To reach the end point in the titration of a 10 ml sample of H_2O_2, 34.0 ml of 0.10*M* $KMnO_4$ are required. What is the molarity of the hydrogen peroxide sample?

4. In your own words, write the purpose of this experiment.

DATA AND OBSERVATIONS:

Final volume of $KMnO_4$
Initial volume of $KMnO_4$

CALCULATIONS:

1. Calculate the number of ml. of 0.10*M* $KMnO_4$ used to titrate your sample of hydrogen peroxide.

2. How many moles of $KMnO_4$ are required to oxidize the hydrogen peroxide?

3. Use the equation you balanced in prelab question 1 to determine the moles of hydrogen peroxide that are reduced by the moles of $KMnO_4$ in calculation 2.

4. Calculate the molarity of the hydrogen peroxide solution.

5. Use your data to calculate the percent by mass of hydrogen peroxide in the solution.

ANALYSIS AND CONCLUSIONS:

1. Why is this redox titration an easy system to monitor?

2. Can you think of a way that this redox reaction can be carried out and monitored without titration?

SYNTHESIS:

1. Write the electron dot diagram for hydrogen peroxide.

UNIT: GASES

MOLAR RATIOS USING MASS AND VOLUME

Avogadro's hypothesis tells us that equal volumes of gas measured at the same temperature and pressure contain an equal number of particles.

Solids and gases are often contained in the same experiment. The mass of the solid can be found on a balance, but to find the mass of a gas is a little more difficult. Chemists usually measure the volume of a gas, then convert the volume to mass. Using this idea, the chemist must know the relationship between the molar mass and the molar volume. Avogadro's hypothesis is this relationship. Your measurements will be observed at room temperature and pressure. You will then convert to standard conditions, STP, to finish the experiment.

In this experiment, you will investigate the importance of Avogadro's hypothesis.

EQUIPMENT:

400 ml. beaker
One hole rubber stopper
50 ml. gas measuring tube
Thermometer
Barometer
Pair of calipers
2000 ml graduated cylinder
Clamp
Ring stand
Piece of copper wire
Piece of magnesium

PROCEDURE:

1. When you go into the laboratory, take a 600 ml beaker and fill it three/fourths full with tap water. This will allow the water to stand and come to room temperature.
2. While you are waiting for the water to come to room temperature, take a piece of magnesium metal and find its length to the nearest 0.01 cm with a pair of calipers. **Record this length.**
3. Prepare the ring stand and clamp to hold the gas measuring tube.
4. Take the copper metal and put it through the hole in the stopper. On the end of the copper that will be inside the tube, make a cage like structure (teacher's instructions). Wrap the magnesium metal around the cage, but make sure it is not wound around too tightly. Make sure the magnesium and the copper will go inside the gas measuring tube.
5. Invert the tube and add approximately 10 ml of HCl.
6. Slowly fill the tube to the top with the tap water from the beaker from STEP 1.
7. Insert the rubber stopper with the copper and magnesium into the gas measuring tube.
8. Put your index finger over the hole in the stopper and place the tube right side up and into the 400 ml beaker. When the hole is below the surface of the water, release your finger. No air should have gotten in the tube. (If in doubt, ask your teacher.)
9. The reaction will not start immediately, for the HCl has to diffuse down to the magnesium. When the reaction is complete, gently tap the gas collecting tube with your finger to release any trapped gas. Note the column of gas in the tube.
10. Place your index finger over the hole in the rubber stopper while your partner undoes the clamp to the tube. Keep your finger over the hole and take the tube to the nearest sink and place it in a filled 2000 ml graduated cylinder. Remember: do not release your finger until the stopper is below the surface of the water.
11. Move the tube up or down until the level of the water in the tube is the same as the level of water in the graduated cylinder. Record this volume.
12. Record the temperature of the room, the barometric pressure in cm of Hg, and the mass of 1.00 meters of magnesium metal.

DATA: The table is left out for you to construct and fill out.

CALCULATIONS:

1. Calculate the mass of magnesium metal, using the mass per meter given to you by your teacher. Hint: 5 cm = 0.05 meter
2. Calculate the moles of magnesium.
3. Calculate the partial pressure of the hydrogen gas in the hydrogen gas water mixture. (For partial pressure of water vapor consult the attached page)
   Remember that $P_{total} = P_{H2O} + P_{H2}$
4. You know the volume of hydrogen gas at the corrected pressure, (calculation #3), and at room temperature. Now calculate the volume of hydrogen gas at STP.
5. You now know the volume of the hydrogen gas at STP. Use this information to calculate the volume of hydrogen gas which would be produced if one mole of magnesium were reacted with an excess of HCl.

QUESTIONS:

1. Write the balanced equation for the reaction in this experiment. If the water was boiled away, the white residue remaining would be magnesium chloride. Also show the molar relationship between the magnesium and the hydrogen gas.
2. From this experiment you should be able to predict the volume that one mole of hydrogen gas would occupy at STP. What is this volume?
3. Calculate the volume of hydrogen gas and the mass of magnesium chloride that would be produced if 2.43 g of Mg reacted with an excess amount of HCl.

Physical Science Unit Plans

Newton's Laws of Motion

Electricity and Magnetism

Heat, Temperature and Engines

Measurement

Planning group members:

Yolanda Hall, Sadie Daniels, Cecil McClendon, and Marilyn Bielefeld

Unit name: **Newton's Laws of Motion** Suggested time: **3 weeks**

Objectives

Concepts to be learned The student will:

1. Explain how a moving object can create a force to push another object through a distance to do work.
2. Identify common forces that act upon their body and all matter.
3. Use diagrams of industrial machines and people in work environments to show how many forces can act on an object at the same time creating balanced and unbalanced conditions
4. Make value judgments deciding if the work created by moving masses is constructive or destructive.
5. Theorize how these forces are used by industries to do work.
6. Apply their knowledge of motion, speed, velocity, force, momentum, and acceleration to demonstrate the math relationship between mass and motion as stated in Newton's three laws.

Skills to be acquired: The student will:

1. Measure mass, length and distance using the proper metric units and tools.
2. Calculate speed, velocity , acceleration and force from their collected data.
3. Using two variables organize numerical data into charts that will be graphed.
4. Interpret graphs and charts to make predictions.

Workplace Relationships

1. The student will take pictures of cars, heavy machines, and vehicles used to move heavy objects and illustrate how forces are acting as vectors to do work by moving things.
2. The student will take rating charts for crane cables and predict how heavy a load they can carry according to the mass of the load.
3. The students will calculate the force and momentum created by a boom hitting an object when the mass/motion relationship is given. They will determine what type of weight is needed to knock down larges forces.

Learning activities / Teaching strategies to use

1. Inquiry lab - Vocabulary (Inertia, volume, second, average time, volume initial, volume final, average volume.)

SAMPLE WEEK ONE ACTIVITIES FOR NEWTON'S FIRST LAW

DAY ONE

After a short skills demonstration use a graduated cylinder to measure different volumes of liquids. The students will practice measuring the amount of water in a coffee cup, chart their data and record the average volume.

Evaluation: The students will compare their average to the teacher's value.

DAY TWO

After a short skills demonstration, use a stop watch to time a four team relay. The students will organize a 4 member relay team and time themselves in a walking relay, chart their data and record the average time for 3 relays.

Evaluation: The students will calculate the average appropriately.

DAY THREE

After a short skills demonstration of charting and graphing information, the students will graph data supplied by the teacher relating to variables that may be used on a career work site.

Evaluation: The teacher will grade the graphs.

DAY FOUR

The students will have a coffee relay. They will measure the time to complete the relay per team and the amount of water left in the cup at the end of the relay. Using their charted

data, the students will graph the relationship of time versus volume of water to determine a cause and effect relationship.

Evaluation: Lab report

DAY FIVE

After a brief lecture demonstration of the vocabulary as it relates to Newton's first law, the teacher will move suddenly with a full cup of water, followed by pulling the tablecloth from under some organized masses. Within small groups, the students will analyze their data, predicting their hypothesis as they relate to Newton's first law to answer lab questions with passive help from the teacher.

Lab objectives for week one

The student will be able to explain why the water came out of the cup as the race progressed.
The student will be able to calculate averages.
The student will compare the race time to the amount of water left in the cups.
The student will infer that mass resist changes in motion.
From their charts and graphs, the student will predict the wining team of a relay race using a marble in a plate.

Teaching strategies and additional activities

The science classes will make use of inference labs and hands-on based laboratory experiments. We will make use of brief lectures, skills demonstrations, cooperative learning styles and problem-solving activities congruently with video media. We shall identify the objective being taught and its career application. The students will conduct all activities in an exploratory manner with minimal guidance from the teacher. The textbook will be used as a reference guide for exploratory reading while researching data to make inferences.

For the remainder of Newton's Laws, the students will conduct experiments emulating the first week. The labs will be progressional, integrating hands-on activities, worksheets that spark inferences during exploratory reading and group cooperation. The labs will relate to each other, integrating common concepts and skills.

Other suggested activities

Physical Science, Robert Horton, Macmillan Publishing Company, 1986, pp. 13-16, 99-102.
Physical Science, David Newton, Scott, Foresman and Company, 1983, test pp.. 9-12.
Principles of Science, Book One, Kaskel, Dalton, and Baruch, Charles E. Merrill Publishing Co., 1979, pp. 45-48..
Physical Science (spirit master activity book), Barman, Rusch, Schneiderwent, and Hindin, Silver Burdett Company, 1979, pp. 43-45
Experiences in Physical Science, Laidlaw Brothers, pp. R49-R52

Evaluation (other than paper and pencil exams)

The students will write lab reports explaining how their data is related to the principled learned. (analytical testing)
The students will be asked to demonstrate measuring skills learned. (hands-on test)
The students will be asked to make hypotheses predicting answers to simulated labs.
The students will make charts and graph the data they charted. (math skills demonstration test)
The students will be given standardized criteria testing to test their ability to think in the abstract.

Planning group: Cecil McClendon, Sadie Daniels, Yolonda Hall, and Marilyn Bielefeld

Unit name: **Electricity and Magnetism** Suggested time: **3 weeks**

Objectives

Concepts to be learned

1. Name units used in the metric system and make measurements using them.
2. Describe some of the uses of electrostatic devices.
3. Describe the electromagnetic spectrum and the wave phenomenon associated with it.
4. Describe the nature of an electric current.
5. Identify five sources of electric current.

Skills to be acquired

1. Demonstrate various methods of producing electric charges.
2. Compare the function of series and parallel circuitry.
3. Demonstrate the ability to interpret information from a data table.
4. Analyze how coils and transformers are used.
5. Explain the photoelectric effect.

Workplace relationships

1. An electrician will need to know the relationships that exist between switches and series and parallel circuits.
2. A radio and television repairman should know the relationship that exists among volts, amperes, and Ohms.
3. A meter reader for a utility company will know the units of measurement in the metric system.

Learning activities / Teaching strategies to use

Days 1-2 (1) Students will perform the lab activity on forces of attraction and repulsion, and will observe the interaction of two objects and infer the cause of the attraction and repulsion between them.

Days 3-4 (2) Student will demonstrate how the addition and the removal of light bulbs affect a series circuit. In this activity, students model series and parallel circuits and collect data on their characteristics.

Days 5-6 (3) Students will demonstrate the ability to set up an electromagnet and to determine what has the most effect on its strength. In this activity, the student will experiment with several electromagnets in order to draw conclusions about the characteristics that affect their strength.

Days 7-9 (4) Making an electrochemical cell lab. In this activity, students will model an electrochemical cell and collect data on the effect of using different electrode pairs. Students will also demonstrate how galvanometer readings of an electrochemical cell vary with electrode composition.

Days 10-11 (5) Electrolytes and current lab. In this activity, student will collect data on the concentrations of electrolytes and their effect on current generated, organized data in table form, and analyze data by preparing a graph.

Days 12-13 (6) Static transmitters lab. In this activity, student will experiment with various procedures of electrical discharges and communicate how these discharges affect radio reception.

Evaluation (other than paper and pencil exams)

1. Students will demonstrate the ability to read an electric meter and to calculate a monthly bill when given the cost per kilowatt-hour.
2. As a project, students will construct both series and parallel circuits and explain the function of each.

Planning group: Cecil McClendon, Sadie Daniels, Yolonda Hall, and Marilyn Bielefeld

Unit name: **Heat, Temperature and Engines** Suggested time: **3-4 weeks**

Objectives

Concepts to be learned The student will-

1. Distinguish between heat and temperature.
2. Demonstrate the relationships between friction and heat.
3. Describe the difference between Celsius and Fahrenheit temperature,
4. Describe the process of heat transfer by conduction, convection and radiation.
5. Describe and illustrate methods that man can use to conserve heat energy.

Skills to be acquired

Measure temperature with a Celsius and a Fahrenheit thermometer; time, record, construct a graph, compare, measure volume, problem solve, define, explain, arrange, organize, group, list, convert, infer, submit, demonstrate, utilize, show and design.

Workplace relationships

Heating and cooling specialist, large engine repair (automobile, truck repair), small engine repair, building contractor (heating and cooling, insulation), fashion design (insulation), food service technician, laboratory technician, practical nurse, aircraft mechanic and ceramics.

Learning Activities / Teaching strategies to use

Students should keep a notebook to be used as their portfolio. Graphs that are constructed will be stapled in their notebooks. All activities will be done in small groups.

HEAT and TEMPERATURE

Objective: To be able to distinguish between heat and temperature.

Materials: Ring stand, ring, wire screen, water, graduated cylinder, beaker, heating source, water, paper, pencil, and graph paper.

Activity:

1. Set up ring stand as modeled by teacher. Place over heat source.
2. Use graduated cylinder to measure 50 milliliter of water and pour into a beaker.
3. Record under data the starting temperature for 50ml. Turn on the heat source and stir for 30 seconds (without thermometer). Place thermometer in the water without touching sides or bottom of beaker and after 60 seconds, record the final temperature. Place all information in notebook (portfolio).
4. Repeat the above steps with 150ml., 250ml., 350ml., and 500ml., of water and record the information.
5. Find the temperature change by subtracting the beginning temperature from the final temperature and record.
6. Construct a graph comparing the mass of the water with temperature change. (1ml. = 1g.)

Students will be able to-

--define heat and temperature.
--compare and contrast heat and temperature
--tell what happens to change in water temperature as mass increases.

Celsius and Fahrenheit Thermometers

Objective: To see the relationship between Celsius and Fahrenheit thermometers.

Materials: Celsius / Fahrenheit thermometers, water, beaker, ice, heat source, graph paper.

Activity:

1. Record under data the room temperature for both types of thermometers.
2. Make a chart (also under data) to record the temperature for every minute until the water

boils for both Celsius and Fahrenheit.
3. Record the temperature using the Celsius thermometer until the water boils.
4. Repeat the above steps using a Fahrenheit thermometer.
5. Construct a graph (time vs. temperature) and show both sets of information.
6. As a member of a group, record the temperature from a bank clock twice a day for several days in both Celsius and Fahrenheit degrees.
7. Record the high and low temperatures from the weather report for several days and convert to Celsius degrees using the formula C=5/9 (F-32).
8. Take several temperatures that were recorded during the activity and change to Celsius.
9. Take the Celsius temperatures as recorded in the chart and change to Kelvin by adding 273 degrees to each.

Students will be able to--
--know freezing and boiling points of water in Celsius, Fahrenheit and Kelvin degrees.
--be able to convert from one scale to another.

CONDUCTION, CONVECTION and RADIATION

Objective: To be able to describe the process of heat transfer by conduction, convection and radiation.

Materials: Samples of copper, aluminum, glass, rubber, steel and wood strips, freezer (or ice), water, heat source and styrofoam cups.

Activity: Conduction
1. Place samples in freezer (or with ice) and leave for at least an hour before doing activity,
2. Make a chart to record under data with numbers from 1 to 6 to write in names of samples from coldest to warmest.
3. Touch each sample with a different finger and rank with 1. being the coldest.
4. Measure 5 centimeters down from the top of a cup and mark with a pencil.
5. Fill cup to mark with hot water and record the time required (also under data) to feel the heat for each sample.

The student will be able to-
--observe the conduction of heat.
--see that some materials conduct heat better than other materials.

Convection and Radiation
1. Set up a ring stand as above with a beaker 3/4 full of water.
2. Add a drop of food coloring to one side of beaker (do not stir).
3. Gently warm the same side of the beaker and record observations.
4. Define the words conduction, convection and radiation.
5. Give examples of heat sources that keep you warm in cold weather and make a chart placing them under the headings of conduction, convection or radiation.
6. Take two cups and make a lid for each, one with white and one with black construction paper.
7. Place each cup near a light bulb and record the temperature of each at the end of the class period. Compare the results.

The student will--
-be able to give examples of conduction, convection and radiation.
-observe that some materials absorb or reflect radiation better than others.

INSULATION

Objective: To observe how some materials conserve heat energy.

Materials: Containers (glass jars, tin cans, plastics cups etc.) with lids, insulating materials (cotton, aluminum foil, various fabrics etc.), graduated cylinder, ice, watch

Activity:

1. Divide into groups of three or four people.
2. Each group should take various containers and cover each with an insulating material (tape if necessary).
3. Add ice cubes to containers and seal.
4. Leave for at least 30 minutes.
5. Pour water formed in a graduated cylinder and record amounts for different combinations. Compare results.
6. Tell which substances were the best insulators.

The students will be able to observe that some materials are better insulators than other materials.

ENGINES

Objective: To see how engines use heat energy to do work.

Activity:

1. Have students divide into small groups (three or four people)
2. Each group should list all engines that they see or use in everyday life.
3. Read their list to other members of the class.
4. Take their lists and divide into three groups(electric, gasoline or steam engines)
5. Each group should ask any family members who work with engines to tell them about their work and write a short report on what they learned to be reported to the rest of the class.
6. A visit should be arranged to the auto repair shop in the school if available.

OTHER ACTIVITIES

1. Have maintenance person show students the heating system of the school and explain to them how it works.
2. Arrange a visit to NIPSCO (Public Service Company) to see how heat gets to your home.
3. Visit a home that has solar heating and explain how it works.
4. Have a speaker who works with heating and air conditioning explain about various aspects of their jobs and illustrate various heating systems.
5. Divide the students into small groups and let them pick a type of heating system of which to make a model or drawings and make a presentation to the rest of the class.
6. Show a video about global warming and have a discussion on what can be done to prevent it.

Evaluation (other than paper and pencil exams)

Attendance, group participation, teacher graded notebooks and graphs, oral questions, completion of homework assignments, grades for presentations and models

Resources:

Videos:

The Heat is On--The Effects of Global Warming , Solar Energy-- Hope for the Future, Weatherization and Insulation, Energy Conservation (Home Improvement), How the Automobile Works-- It's Really Not Your Enemy, Car Care Series-- Get the Basics, 1993 Power Steam Show-(Steam Engines-History).

Books:

Modern Physical Science, Holt, Rinehart and Winston Inc., Harcourt, Brace, Jovancevich, Inc., 1991.

Focus on Physical Science, Heimler, Charles and Price, Jack, Merrill Publishing Co., 1987.

Physical Science, Hurd, Dean and Silver, Myrna, Prentice-Hall, 1993.

Planning group: Cecil McClendon, Sadie Daniels, Yolonda Hall, and Marilyn Bielefeld

Unit name: **Measurements: Linear, Volume, Mass Temperature**

Suggested time: **2 weeks**

Objectives:

Concepts to be learned: Students will be able to:

1. Determine the dimensions, mass and volume of objects within the acceptable error of the apparatus.
2. List at least three reasons for using the metric system.
3. Measure the speed at which something moves using proper units.
4. Compare and contrast standards of measurement.
5. Give examples of how the sense of sight, touch and sound can be used as tools of measurement.
6. Draw an object from a given set of measurements in metric units.

Skills to be acquired

1. Measure with metric ruler.
2. Measure volume with graduated cylinder.
3. Measure mass using the metric system.
4. Submit three reasons for using the metric system.
5. Estimate length and mass of given objects.
6. Create a dialog (composition) using metric units.

Workplace relationships

1. Technical engineers use measurement to determine the volume and mass of quantities being produced.
2. Dentists use a metric ruler to find the depth of gum tissue around teeth.
3. Pharmacists use measurement to determine the amount of medicine to be dispensed to patients.
4. Opticians use measurement to determine the size of the eye ball when fitting for contact lenses.
5. Product technicians use measurement to place information on labels of food products.
6. Nurses take vital signs, weight and height of patients.

Learning activities/Teaching strategies to use

1. Assign students to observe in their home and while out for items that use metric units for measurements; bring some representatives to class. Discuss observations; comparison between estimation and with mathematical formulas. What kind of work/business requires measurements on a daily basis?
2. Students are placed in small groups and use a meter stick to measure each team member's height. They must:
   - appoint each a job role
   - decide a method for measuring each height
   - convert metric units to English
   - compare girls' height to boys' height on a graph.
3. Cooperative learning groups will be given 10 items to measure using as many of the categories as would apply. Each member will measure the 10 items the same way and report his/her data to the group. The group processes the data, finds the data and determine at that time, "does it make sense?"
4. Students use body parts: tip of elbow to tip of middle finger, feet and palm of hand for measurement; record data. Next, measure with a metric ruler; record data. Compare body measurements to ruler measurements. Did each member get the same result? Explain why there must be a standard for measure.
5. Counting and estimation of stomata in a Wandering Jew leaf: A microscope will be used to measure the stomata in the leaf of the plant Tradescantia. The area of the leaf is then

calculated in square millimeters and in square centimeters and the number of stomata on the leaf is then estimated.

6. "How Healthy Are You?" Students are given, "How Healthy Are You Quiz" and results are discussed. Vital equipment is used to measure systolic/diastolic pressure, temperature, respiratory and pulse rates. Data is collected and compared.
7. Cooperative learning groups will build a scale model with play dough of a form necessary to pour a garage floor - 6"x20'x40'.
8. How accurate is an estimation? Students practice estimating measurements. They will check their estimates for accuracy, find the amount of error, compare results and graph using a histogram.
9. Design methods for measuring some objects assigned by the teacher without using the instruments they have been using. They must also establish appropriate units for their measurements.

Evaluation

Points for bringing representatives to class, teacher checklist, participation in group, a student/teacher assessment checklist, points for measurements and calculations, points for project, and data collected.

Materials

Plain white paper, sheets of graph paper, metric rulers, stop watch, droppers, water, 10-ml graduated cylinder, triple-beam balance, microscopes, glass slide/cover slip, wandering Jew plant, forceps, clear plastic rulers, calculators, play dough, beakers, 50-ml graduated cylinders, thermometers, oral thermometers, blood pressure cuff, stethoscope, respiratory meters, objects, and colored pencils.

Resources

Videos, laser disc, textbook, laboratory manual, computer, study guides, teachers, and environment.